Discoid Lateral Meniscus Tears and Concomitant Articular Cartilage Lesions in the Knee

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Purpose: The purpose of this study was to investigate the relation between isolated discoid lateral meniscus (DLM) tears and the presence of articular cartilage lesions. **Methods:** From January 2010 to January 2012, 252 consecutive patients diagnosed with an isolated DLM tear during an arthroscopic procedure were included in this study. Demographic variables, including gender, age, body mass index (BMI), traumatic history, time course, and date of the DLM tear, were recorded. The relation between DLM tears and the presence of articular cartilage lesions was analyzed by the χ^2 test. Logistic regression analysis was used to analyze the relation between these variables and articular cartilage lesions. **Results:** Of the patients with DLM tears, 67 (26.6%) also had articular cartilage lesions. The most common type of DLM tear was the complex tear (46.8%). The most common location of articular cartilage lesions was the lateral tibial plateau (11.6%). Lesions on the opposing articular surfaces of the lateral compartment and patellofemoral joint of the knee were found in 12 patients (4.8%) and 11 patients (4.4%), respectively. There were no significant differences in the incidences of articular cartilage lesions in patients with different types of DLM tears ($P > .05$). Gender (odds ratio [OR], 2.289; $P = .012$), BMI (OR, 1.991; $P = .023$), and time course (OR, 2.050; $P = .034$) were significantly associated with articular cartilage lesions. **Conclusions:** DLM tears were more common in the context of degenerative tears. There was no significant difference in the incidence of articular cartilage lesions among patients with different types of DLM tears. Female patients, patients with a BMI greater than 23.0 kg/m^2, or patients with a time course of greater than 6 months were more frequently observed to also have articular cartilage lesions. **Level of Evidence:** Level IV, therapeutic case series.

Discoid meniscus is an abnormal morphology of the meniscus and was first described by Young[1] in 1889. Discoid meniscus occurs more often in the lateral meniscus than in the medial meniscus. The incidence of lateral discoid meniscus ranges from 0.4% to 17%, as compared with 0.06% to 0.3% for medial discoid meniscus.[2] The incidence of discoid meniscus is about 16.6% in Japanese populations[3] and 10.9% in Korean populations[4] but is quite low in white populations (0.4% to 5%).[5] Moreover, the prevalence of bilateral discoid lateral meniscus (DLM) in the Asian population who present with symptomatic DLM has been reported to be as high as 79%.[6] The body of the DLM is much thicker than that of the normal meniscus and lacks vasculature. The ultrastructure of the discoid meniscus is also different from that of the normal meniscus.[7] All these characteristics make DLM patients more vulnerable to injury. Articular cartilage lesions are usually present with DLM tears.[8] Abnormal distribution of mechanical stress is regarded as a risk factor for articular damage.[9] Many studies have also shown that patients who underwent meniscal surgery with concomitant cartilage lesions had poorer results than patients without cartilage lesions.[10-12] In addition, the lateral meniscus plays a very important role in transmitting mechanical stress, and lateral meniscectomy is a riskier procedure than medial meniscectomy.[13,14] Because of the special morphology of DLM, the features of articular cartilage lesions may be unique.

Clinical studies have explored the probable relations between the type of meniscal tears and articular cartilage lesions. However, the coexistence of meniscal tears and articular cartilage damage is a controversial topic. The coexistence of meniscus tears and articular cartilage lesions may make it more difficult for clinical tests to determine the exact source of a patient's symptoms. Christoforakis et al.[15] reported that degenerative meniscal tears (complex and horizontal) are significantly

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associated with articular cartilage lesions; Lewandrowski et al.[16] found that articular cartilage damage is significantly associated with longitudinal, bucket-handle, and complex tears; and Henry et al.[17] observed that meniscus tears with increasing disruption of the circumferential meniscal fibers are significantly associated with articular cartilage lesions. Furthermore, some studies have reported that there is no relation between the type of meniscal tear and the presence of articular cartilage lesions.[18,19] However, the relation between isolated DLM tears and articular cartilage lesions has never been investigated.

The purpose of our study was to investigate the relation between isolated DLM tears and the presence of articular cartilage lesions. We hypothesized that DLM tear type, gender, age, body mass index (BMI), time course, trauma history, and DLM type (complete or incomplete) would be significantly associated with articular cartilage lesions.

Methods

From January 2010 to January 2012, 308 consecutive patients diagnosed with a DLM tear at our center were prospectively enrolled in this study. All patients were diagnosed with DLM tears according to symptoms, physical examinations, and magnetic resonance imaging (MRI) results. All of the patients who underwent surgery were symptomatic. Arthroscopic surgery was indicated in patients with failure to respond to conservative treatment for 3 clinical visits within 3 months or patients with mechanical symptoms such as locked knee. The inclusion criterion was diagnosis of a DLM tear under arthroscopy. The exclusion criteria included (1) history of surgery on the same knee, (2) presence of a medial meniscus tear or lesions of the cruciate and collateral ligaments, (3) presence of synovitis or rheumatoid arthritis, (4) presence of fractures or loose bodies, (5) presence of diffuse cartilage lesions, (6) presence of osteochondritis dissecans, and (7) presence of osteoarthritic characteristics on knee radiographs.

Among the 308 patients, 44 who had medial meniscus tears were excluded from the study. Three patients with pigmented villonodular synovitis and 1 patient with rheumatoid arthritis were excluded. Five patients with osteochondritis dissecans were excluded. In addition, 8 patients who had collateral ligament ruptures, posterior cruciate ligament ruptures, loose bodies, patellar dislocation, and fractures of the tibial plateau were excluded. Finally, 252 patients were assigned to the study.

All case histories, operative records, and colorized photographs taken using arthroscopy during the operation were collected. Patient gender, age, BMI, trauma history, and time course (i.e., the time from the onset of symptoms to arthroscopic surgery) were also recorded. Pain and painful catching and locking were regarded as indicating the onset of symptoms. Patients were considered to have a nontraumatic history if they could not recall the occurrence of any knee-related injury. All surgeries were performed by 3 surgeons who had more than 5 years of experience performing arthroscopic surgery. The process of all surgeries was recorded with videos and photographs. The type of DLM (complete or incomplete), type and location of DLM tears, and presence of articular cartilage lesions were recorded. The second author examined all the videos of arthroscopic surgery independently and verified the type of DLM tears and presence of articular cartilage lesions. The severity of articular cartilage lesions was documented according to the International Cartilage Repair Society classification,[20] which classifies the severity of cartilage lesion into 4 grades: grade I, superficial lesions, cracks, and indentations; grade II, fraying, lesions extending down to $<50\%$ of the cartilage depth; grade III, partial loss of cartilage thickness, cartilage defects extending down to $>50\%$ of the cartilage depth and down to the calcified layer; and grade IV, complete loss of cartilage thickness, bone only.

The location of articular cartilage lesions was documented on a grid according to the International Cartilage Repair Society articular cartilage injury mapping system. This mapping system divides the knee into 6 parts: medial femoral condyle (MFC), lateral femoral condyle (LFC), patella, trochlea, medial tibial plateau (MTP), and lateral tibial plateau (LTP). The DLM was divided into anterior, middle, and posterior regions. The DLM tear was classified into 6 types: longitudinal-vertical tear, horizontal tear, radial tear, oblique tear, peripheral tear, and complex tear. Complex tears were considered to be all tears containing at least 2 different types of meniscus tears. The demographic data of patients are listed in Table 1.

For continuous data, independent-sample t tests were used to compare 2 groups and 1-way analysis of variance was used to compare 3 or more groups. We used χ^2 tests to compare categorical data. Gender, age, BMI, trauma history, time course, DLM type (complete or incomplete), and DLM tear type were analyzed as potential prognostic variables for articular cartilage lesions. According to the method described by Ding et al.,[21] all variables were transformed into logistic data as follows: (1) gender (0, female; 1, male); (2) age (0, age $\leq$16 years; 1, age $>$16 years); (3) BMI (0, BMI $\leq$23 kg/m^2; 1, BMI $>$23 kg/m^2); (4) trauma history (0, no; 1, yes); (5) time course (0, $\leq$6

Table 1. Demographic Data for Patients Enrolled in Study

	Data
Mean age at surgery (yr)	33.19 (SD, 14.69; range, 6-50)
Mean BMI (kg/m^2)	21.75 (SD, 3.55; range, 14-33)
Mean time course (mo)	26.64 (SD, 37.85; range, 0.1-240)
Male/female	99/153

months; 1, >6 months); (6) DLM type (0, incomplete; 1, complete); and (7) DLM tear type (1, longitudinal tear; 2, peripheral tear; 3, radial tear; 4, oblique tear; 5, horizontal tear; 6, complex tear). Binary logistic regression analysis was used to analyze the relations between these variables and articular cartilage lesions. Differences were considered statistically significant at $P < .05$. All statistical analyses were performed with PASW Statistics software (version 18.0, SPSS, Chicago, IL).

Results

Most patients (145 of 252) did not recall a history of trauma related to the operative knee. Forty-one patients were aged 16 years or younger, and the BMIs of 90 patients were greater than 23 kg/m^2. In addition, most patients (169 of 252) had a time course of more than 6 months, and 195 patients had complete DLM whereas 57 had incomplete DLM. The frequency of oblique tears (2.8%) was the lowest among all the types of tears, whereas that of complex tears was up to 46.8% (Table 2). The mean ages of patients with different types of DLM tears did not differ significantly ($P = .54$). The mean BMI was significantly associated with the type of DLM tear. Patients with oblique tears were significantly heavier than patients with peripheral tears, horizontal tears, and complex tears ($P < .05$).

The frequencies of isolated horizontal tears and peripheral tears were 16.7% and 19.4%, respectively. In addition, among the patients with complex tears, horizontal tears and peripheral tears were also frequently observed. In total, 134 patients (53.2%) had horizontal tears and 133 patients (52.8%) had peripheral tears.

Most patients had tears in the middle (84.5%) and posterior (68.7%) regions. Tears in the anterior region were present in 39.7% of patients. Simultaneous tears in the middle and posterior regions of the DLM occurred in 136 patients (54%), and the most frequent type of tear was peripheral combined horizontal tears in these patients.

Articular cartilage lesions of the knee were discovered in 67 patients (26.6%). Among all patients, 37 (14.7%) had a single cartilage lesion within the knee, 23 (9.1%) had 2 lesions, 4 (1.6%) had 3 lesions, 2 (0.8%) had 4 lesions, and 1 (0.4%) had 5 lesions. Moreover, most of the articular cartilage lesions were located in the patellofemoral joint of the knee (44.4% in patella and trochlea) and lateral compartment of the knee (42.6% in LFC and LTP). Only 13.0% of the articular cartilage lesions were located in the medial compartment of the knee (MFC and MTP).

The most common location of articular cartilage lesions was the LTP (11.6% of all patients) (Fig 1). Among patients with lesions in the LTP, 34.5% were identified as having grade III or IV lesions. Grade III or IV lesions accounted for 58.8% of LFC lesions. Moreover, 51.9% of lesions in the patella were grade III or IV, 61.9% of lesions in the trochlea were grade III or IV, and 61.5% of lesions in the MFC were grade III or IV. There were no significant differences in the percentage of grade III or IV articular cartilage lesions among the different locations ($P > .05$). Articular cartilage lesions were not frequently observed in the MTP.

Table 2. Frequency of Meniscus Tear Type and Demographic Data

Type of Tear	Frequency (n)	%	Mean Age (yr)	Mean BMI (kg/m^2)
Longitudinal	16	6.3	33.4	21.5
Peripheral	49	19.4	34.6	21.5*
Radial	20	8.0	34.6	23.1
Oblique	7	2.8	38.1	24.6*
Horizontal	42	16.7	29.5	21.5*
Complex	118	46.8	33.4	21.6*

*Statistically significant ($P < .05$).

Thirty-four patients (13.5% of all patients) had articular cartilage lesions in the lateral compartment of the knee. Twelve patients (4.8% of all patients) had articular cartilage lesions on the opposing articular surfaces of the lateral compartment. Thirty-six patients (14.3% of all patients) had articular cartilage lesions in the patellofemoral joint of the knee. Eleven patients (4.4% of all patients) had lesions on the opposing articular surfaces of the patellofemoral joint. Fourteen patients (5.6% of all patients) had articular cartilage lesions in the medial compartment of the knee. However, no patients had lesions on the opposing articular surfaces of the medial compartment.

The locations of articular cartilage lesions varied with respect to the type of DLM tear (Table 3). Three patients with longitudinal tears, 14 with peripheral tears, 5 with radial tears, 3 with oblique tears, 9 with horizontal tears, and 33 with complex tears had articular cartilage lesions. There were no significant differences in the incidence of articular cartilage lesions among the different types of DLM tears ($P > .05$). The incidence of grade III or IV articular cartilage lesions was also not

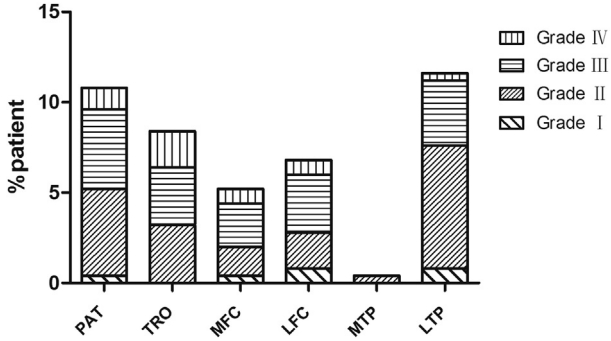

Fig 1. Incidence of articular cartilage lesions in different locations within knee, as well as proportion of lesions graded I through IV. (PAT, patella; TRO, trochlea.)

Table 3. Types of DLM Tears and Locations of Articular Cartilage Lesions

	MFC (%)	MTP (%)	LFC (%)	LTP (%)	Patella (%)	Trochlea (%)
Longitudinal	2 (33.3)	0 (0)	0 (0)	1 (16.7)	1 (16.7)	2 (33.3)
Peripheral	3 (12.0)	1 (4.0)	3 (12.0)	6 (24.0)	7 (28.0)	5 (20.0)
Radial	2 (33.3)	0 (0)	0 (0)	0 (0)	2 (33.3)	2 (33.3)
Oblique	1 (25.0)	0 (0)	0 (0)	1 (25.0)	2 (50.0)	0 (0)
Horizontal	2 (13.3)	0 (0)	1 (6.7)	5 (33.3)	3 (20.0)	4 (26.7)
Complex	3 (5.8)	0 (0)	13 (25.0)	16 (30.8)	12 (23.0)	8 (15.4)

significantly different among patients with different types of tears ($P > .05$).

Univariate logistic regression was first conducted to screen for variables that were significantly associated with articular cartilage lesions (Table 4). Gender, BMI, and time course were prognostic variables for cartilage lesions ($P < .05$). Four variables were excluded in the preliminary analysis: (1) age (odds ratio [OR], 1.601; $P = .266$); (2) trauma history (OR, 1.047, $P = .874$); (3) DLM type (OR, 0.727; $P = .333$); and (4) DLM tear type ($P > .1$). The 3 remaining variables were analyzed by multivariate logistic regression. After multivariate logistic regression, gender, BMI, and time course were still significantly associated with cartilage lesions (Table 5). The results showed that articular cartilage lesions occurred more frequently in female patients (OR, 2.289; $P = .012$), patients with a BMI greater than 23.0 kg/m^2 (OR, 1.991; $P = .023$), and patients with a time course greater than 6 months (OR, 2.050; $P = .034$).

Discussion

No prior studies have investigated the relation between isolated DLM tears and the presence of articular cartilage lesions. We evaluated 252 patients who were diagnosed with an isolated DLM tear during arthroscopy. There were no significant differences in the incidences of articular cartilage lesions in patients with different types of DLM tears ($P > .05$). Gender, BMI, and time course were significantly associated with articular cartilage lesions, thus partly supporting our hypothesis.

In a large retrospective study of 25,124 knee arthroscopies, a 60% incidence of articular cartilage lesions was found, and the most common locations of articular cartilage lesions were the patella and MFC.[22] Nevertheless, Deie et al.[23] reported a high incidence of osteochondritis dissecans in patients with DLM, and articular cartilage lesions were mostly located in the LFC. This was attributed to the high incidence of DLM in the Japanese population. This suggested that DLM tears may have a unique relation with articular cartilage lesions. Therefore a better understanding of the relation between isolated DLM tears and the presence of articular cartilage lesions is necessary to develop more reasonable treatment protocols.

Horizontal tears and complex tears are considered degenerative meniscus tears. Christoforakis et al.[15] carried out a case-series prognostic study of 497 consecutive knee arthroscopies and showed that complex and horizontal cleavage meniscal tears were highly associated with an increased incidence and severity of articular cartilage degeneration compared with other types of tears (longitudinal, bucket handle, flap, and radial). Englund et al.[24] studied 155 patients with intact cruciate ligaments who had undergone meniscectomy a mean of 16 ± 1 years earlier. They also concluded that degenerative meniscal tears were associated with poor outcomes and that degenerative meniscal tears may be associated with incipient osteoarthritis (OA). Lewandrowski et al.[16] analyzed the frequency of concomitant meniscal and articular cartilage lesions in the femorotibial joint in

Table 4. Results of Univariate Logistic Regression

	OR	95% Confidence Interval for OR	β Coefficient (SE)	*P* Value
Female gender	2.594	1.379-4.880	0.953 (0.322)	.003
Age (yr)	1.601	0.699-3.668	0.471 (0.423)	.266
BMI (kg/m^2)	2.180	1.231-3.860	0.779 (0.292)	.008
Trauma history	1.047	0.595-1.841	0.046 (0.288)	.874
Time course (mo)	2.062	1.080-3.939	0.724 (0.330)	.028
DLM type	0.727	0.381-1.387	−0.319 (0.329)	.333
DLM tear type*				
Peripheral	1.733	0.427-7.029	0.550 (0.714)	.441
Radial	1.444	0.288-7.245	0.368 (0.823)	.655
Oblique	3.250	0.461-22.927	1.179 (0.997)	.237
Horizontal	1.182	0.276-5.067	0.167 (0.743)	.822
Complex	1.682	0.450-6.286	0.520 (0.673)	.439

*Reference group is longitudinal tear.

Table 5. Results of Multivariate Logistic Regression

	OR	95% Confidence Interval for OR	β Coefficient (SE)	*P* Value
Female gender	2.289	1.198-4.372	0.828 (0.330)	.012
BMI (kg/m^2)	1.991	1.101-3.599	0.689 (0.302)	.023
Time course (mo)	2.050	1.056-3.979	0.718 (0.338)	.034

1,740 knees. Contrary to other studies, Lewandrowski et al. divided meniscus lesions into tears and degeneration. They reported that longitudinal, bucket-handle, and complex tears of the medial meniscus were more often associated with articular cartilage lesions than horizontal, flap, or radial tears. However, the enrolled patients had not only medial meniscus tears but also lateral meniscus tears. In our study horizontal tears and complex tears were very common (63.5%), and only patients with isolated DLM tears were enrolled. We observed no significant difference ($P > .05$) in the incidences of articular cartilage lesions between patients with degenerative tears (horizontal or complex) and patients with other types of tears (longitudinal, peripheral, radial, or oblique). The reason for this discrepancy may be that the DLM is easier to damage and is more prone to degeneration compared with normal types of meniscus.

The relation between meniscal tears and cartilage damage in OA is still controversial. Many studies have reported a high incidence of radiographic knee OA after total meniscectomy.[25,26] However, knee OA can also lead to meniscus tears.[27] Englund et al.[28] studied persons from Framingham, Massachusetts, and found meniscal damage in 35% of right knees among all participants; in addition, 82% of knees with radiographic OA had meniscal damage. Moreover, Englund et al.[29] performed another study that evaluated the association between meniscal damage in knees without surgery and the development of radiographic tibiofemoral OA. They concluded that the presence of a degenerative meniscal tear could be regarded as a sign of early OA. Moreover, they also suggested that additional studies should be conducted to determine the relation between the location and type of meniscal tear and the development of knee OA. Although Washington et al.[30] found that no degenerative changes were evident on the radiographs of 8 patients with DLM tears at long-term follow-up, the patients were still followed up in our study. No patients showed degenerative changes on the radiographs at latest follow-up.

According to 2 large retrospective studies on knee arthroscopy, the most common locations of articular cartilage lesions were the patella and the MFC.[22,31] In our study the most common locations of articular cartilage lesions were the patellofemoral joint and the lateral compartment (especially the LTP) of the knee. One reason for the difference was that we only enrolled patients with isolated DLM tears. Jones et al.[32] analyzed 141 knee arthroscopies performed for any surgical indication at a single hospital; they also found that lateral meniscal tears were most commonly observed in the presence of LTP lesions. Furthermore, Yoshida et al.[33] studied osteochondritis dissecans of the femoral condyle in 38 patients in the growth stage and observed DLM in 12 of 15 knees (80%) with lateral condylar lesions. In another study, 38 knees were diagnosed with osteochondritis dissecans of the LFC, and 34 knees exhibited DLM (89.5%).[23] Kamei et al.[34] studied 63 patients who presented with symptomatic DLM; in 15 of these patients, this was accompanied by osteochondritis dissecans of the LFC. They found that patients with osteochondritis dissecans had a significantly larger condylar prominence ratio than the other patients. A torn DLM may wear the corresponding articular cartilage, making the lateral compartment easy to damage. However, the most important reason for damage may be the change in articular mechanical stress. Finite element analysis has confirmed the abnormal distribution of articular mechanical stress that would lead to degeneration of the articular cartilage.[35,36] In contrast to osteochondritis dissecans, articular cartilage lesions in the patellofemoral joint of the knee were very frequent in our study. This may be related to the abnormal distribution of mechanical stress in the patellofemoral joint due to the presence of DLM tears. Indeed, when Bai et al.[37] investigated the contact pressure and area of the patellofemoral joint both before and after different meniscectomies in 6 fresh cadaveric knees, they found that meniscectomies resulted in disordered distribution of contact pressure, which may be the cause of postoperative anterior knee pain and patellofemoral arthritis. DLM tears also could cause disordered distribution of contact pressure and lead to articular cartilage lesions in the patellofemoral joint. Additional biomechanical experiments are needed to determine how the distribution of contact pressure changes after the occurrence of DLM tears.

In our study complex tears (46.8%) were the most common type of tear. However, many patients with complex tears also had horizontal tears and peripheral tears. Because of this, horizontal tears and peripheral tears presented in more than half of all patients. The DLM covers most of the area of the LTP; therefore the DLM is more vulnerable to compression and shear forces during movement of the knee. Recent studies showed a decrease in the number of collagen fibers, as well as discontinuity and inhomogeneity of the circumferential collagen network, in the discoid meniscus in comparison with the normal meniscus.[7,38] This suggests that horizontal cleavage can occur more easily in the context of DLM. Peripheral tears were mostly located in the middle and posterior regions of the meniscus. One contributing factor may be that the attachment of the lateral meniscus with the joint capsule is unconsolidated and no attachment exists in the popliteal hiatus.

In a large retrospective study of knee arthroscopy, articular cartilage lesions were present in 17% of patients with lateral meniscus tears.[22] Our study showed that 26.6% of patients had articular cartilage lesions. Of the 67 patients with articular cartilage lesions, 37 (55.2%) had 1 lesion whereas 30 (44.8%) had more than 1 lesion. Grade III and IV lesions were regarded as severe articular cartilage lesions. Interestingly, we did not observe a significant difference in the percentages of severe lesions found at different locations of the articular cartilage. The incidence of severe articular cartilage lesions was also not significantly different among the different types of tears in our study. In contrast, Christoforakis et al.[15] found that the incidence of grade III and IV articular cartilage lesions was significantly higher in patients with complex and horizontal meniscal tears than in those with other types of meniscal tears. However, in their study, DLM was present in no more than 20 of 497 patients.

In our study we considered demographic data, including gender, age, BMI, trauma history, and time course. These factors may also have great effects on the articular cartilage in the knee. Four factors (age, trauma history, DLM type, and DLM tear type) were excluded from having significant associations with articular cartilage lesions after preliminary univariate logistic regression ($P > .05$). However, gender, BMI, and time course were entered into the multivariate logistic regression and were still significantly associated with articular cartilage lesions ($P < .05$). Compared with male patients, female patients with DLM tears were more likely to have articular cartilage lesions (OR, 2.289; $P = .012$). The contributing factor may be the disparate anatomic structure between male and female patients. The Q angle in women is usually larger than that in men. This larger Q angle may lead to increased patellofemoral pressure; thus the articular cartilage of the patellofemoral joint in women may be easier to damage than that in men.[39] Obesity has also been reported to be a risk factor for the development of meniscal extrusion.[40] Moreover, meniscal extrusion has been reported to be a potent risk factor for articular cartilage loss.[41] Therefore patients with DLM and high BMIs may have a higher risk of articular cartilage lesions. In our study articular cartilage lesions occurred more frequently when the BMI was more than 23.0 kg/m^2 (OR, 1.991; $P = .023$). A BMI of more than 23.0 kg/m^2 is regarded as detrimental to the health of Chinese individuals. For patients with DLM tears, the larger the BMI, the greater the abnormal mechanical stress, which can damage the articular cartilage. Similarly, Eskelinen et al.[42] also reported that being overweight predisposed young adult men to primary articular cartilage lesions of the knee. In addition, in our study a time course of more than 6 months was a risk factor for articular cartilage lesions (OR, 2.050; $P = .034$). This was in accordance with previous studies in patients with ACL tears. Many studies have reported that delays in ACL reconstruction are associated with more severe articular cartilage lesions.[43-45] Thus a delay in arthroscopic surgery for DLM tears may also be associated with articular cartilage lesions.

Limitations

We acknowledge that there are some limitations to our study. First, the stability of the discoid meniscus was not analyzed as a prognostic variable for articular cartilage lesions. Good et al.[8] emphasized that evaluating the stability of the discoid meniscus was important for developing an optimal treatment protocol. Carter et al.[46] found that the addition of a meniscal stabilization step to the saucerization procedure did not negatively affect either early clinical outcomes or complication rates in patients with demonstrated DLM instability. Second, we were unable to determine whether the causes of the observed articular cartilage lesions were the DLM tears themselves or other injuries, such as previous trauma, synovitis, and other inflammatory diseases of the knee. This may make our conclusions unreliable. Third, root tears are a very important type of meniscal tear, and a meniscus with root tears would lose all its function.[47] However, such tears were rare in our study. We would pay more attention to patients with DLM root tears in future studies. Furthermore, although the total number of patients was relatively large, the results showed no significant differences among the different DLM tear types in our study. Much greater patient numbers would be enrolled in our future studies. Therefore future studies with larger case numbers are needed and should consider the stability of the discoid meniscus and clarify the complex relation between DLM tears and articular cartilage lesions.

Conclusions

DLM tears were more common in the context of degenerative tears. There was no significant difference in the incidence of articular cartilage lesions among patients with different types of DLM tears. Female patients, patients with a BMI greater than 23.0 kg/m^2, or patients with a time course of greater than 6 months were more frequently observed to also have articular cartilage lesions.

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